PATENT NO EP (UK) 0649553

# TRANSLATION OF EUROPEAN PATENT (UK) UNDER SECTION 77 (6) (a)

Rec'd 19.3.97.

Patents Form 54/77

The Patent Office

Patents Act 1977
(Rule 80 and Schedule 4)

The Patent Office

Cardiff Road
Newport
Gwent NP9 1RH

# Filing a translation in connection with a European patent or a European patent application

| | | |
|---|---|---|
| 1. | Your reference | B15556 |
| 2. | European patent number or publication number of application *(or International publication number (see note e))* | 0649553 |
| 3. | Full name and address of the or of each applicant for or proprietor of the European patent (U.K.) | Centre d'Etudes Techniques de l'Equipement de l'Est (C.E.T.E. de l'Est),<br>1 Boulevard de la Solidarité,<br>F-57076 Metz Cedex 03,<br>France. |
| 4. | What kind of translated document listed at note (c) are you sending with this form?<br>*(Answer by writing 1(i), 1(ii), 1(iii) or 2)* | 1(i) |
| 5. | Date when the European patent (UK) was granted or amended | 27.12.1996 |
| 6. | Full name, address and postcode in the United Kingdom to which all correspondence relating to this form and translation should be sent | R. R. Prentice & Co.,<br>Chartered Patent Attorneys,<br>The Hop Exchange,<br>24 Southwark Street,<br>London. SE1 1TY |
| | Patents ADP number | 0001321001 |
| 7. | Do you want the address in part 6 above to be the address for service recorded on the Register or to replace the address for service currently on the Register? | Yes |
| 8. | Signature | Date<br>R.R.Prentice & Co. 14.03.1997 |
| 9. | Name and daytime telephone number of person to contact in the United Kingdom | Mr. R. R. Prentice<br>0171-240 3733 |

PATENTS ACT 1977

IN THE MATTER OF a European Patent (UK) in the name of Centre d'Etudes Techniques de l'Equipment de l'Est (C.E.T.E. de l'Est)

I, AMANDA JANE CONRAD, of 1 Ruscombe Close, Southborough, Tunbridge Wells, Kent, declare that I am conversant with the French and English languages and that to the best of my knowledge and belief the accompanying document is a true translation of the authentic text of European Patent No. 0649553 (formerly Application No. 93 914 823.5).

Signed this 12th day of March 1997

A Conrad

Description

The present invention concerns the field of the analysis of the identification and of the classification of wheeled rolling vehicles or machinery, in particular when they are travelling in the context of their normal use, and relates to a device for detecting, in particular, one or more wheels of a rolling moving vehicle or machine and to a process for the detection, analysis and classification of vehicles or machinery using this device.

At present, there are already various types of system for identifying rolling vehicles which include, in particular, piezoelectric, resistive, optical, ultrasonic and ultrahigh-frequency sensors as well as devices having pneumatic tubes or again electromagnetic loops.

This last type of identification device currently has the form of one or two rectangular loops having large dimensions of the order of 1.5 m to 2 m (2 m being measured in the width direction of the lane) arranged on or in the roadway and allowing a signal representative of the entire body of the vehicle, including the wheels, detected during the passage thereof over the loop or loops to be received. The shape of the signal received and, if applicable, the discrepancy between two signals received by two loops arranged with spacing between them in the direction of travel of the vehicle allow the nature of the light vehicle or heavy goods vehicle as well as its speed of travel to be determined respectively. A device of this type is known, in particular, from the document EP-A-00 35 960.

However, this known device does not allow precise or exact identification of the detected vehicles allowing their classification, in particular, in the ten categories defined by the Organisation for Economic Cooperation and Development (OECD) or in the fourteen categories of the French Data Collection System (SIREDO).

In fact, this device does not detect the number of axles of the vehicle and, to carry out this detection, it is necessary to attach to it an additional device of the pneumatic tube or piezoelectric detector type which notes the passage of the axles as mentioned in FR-A-2 549 625.

This results in a complex assembly requiring constant maintenance owing to the presence of mechanical sensors which are subject to high wear.

The object of the invention is, in particular, to overcome the above-mentioned drawbacks.

To this end, it employs a device constituted by at least one electromagnetic loop positioned on or in the roadway and by a unit for evaluating the influence of the passage of a vehicle past said loop or loops, characterised in that the electromagnetic loop or loops 2 each composed of one or more turns has (have), on the one hand, a small dimension in the direction of travel of the vehicles or of the axis of the roadway, smaller than the diameter of the wheels of the vehicles to be identified and, on the other hand, a preferably rectangular shape and/or an arrangement disposed perpendicularly to the axis of the roadway, the loop or loops being disposed at least in the region of one or two of the rolling tracks of a lane of the roadway and being separately and opposingly sensitive to the electromagnetic influences of the metallic masses of the vehicle body or chassis, on the one hand, and of the metallic masses of the tyres of the corresponding wheels on the other hand. Such loops are known from FR-A-2 254 842, but the known evaluating units exploiting the signals of these loops do not exploit the fact (hitherto unknown in any case) that the influences of the metallic masses of the body and of the tyres on this type of loop are opposed.

The invention relates to a process for the detection, analysis and classification of rolling vehicles or machinery using the aforementioned device, characterised in that it consists in noting the electromagnetic influences, on the one hand, of the metallic masses of the vehicle body or chassis and, on the other hand, of the metallic masses of the tyres of the wheels of said vehicle separately and opposingly by means of at least one electromagnetic loop disposed on or in the roadway and having a small dimension in the direction of travel of the vehicles or the axis of the roadway, in producing a signal indicating the number and position of the wheels relative to each other and relative to the vehicle body or chassis, in identifying the precise nature of the analysed vehicle and in classifying it within predetermined categories, based essentially on the number and longitudinal arrangement of the wheels or of the axles, and in storing the received data for a determined period of time for their subsequent use.

The invention will be understood better by means of the following description which relates to preferred embodiments given as nonlimiting examples and explained with reference to the accompanying schematic drawings.

Figure 1 is a schematic plan view of the device.

Figures 2 to 17 show variations in number, shape and winding direction of the loops forming part of the device according to the invention.

Figure 18 shows the voltage signal generated by a car at the output of the electromagnetic detector forming part of the device according to the invention.

Figure 19 shows the voltage signal at the output of the detector generated by a coach.

Figure 20 shows the voltage signal at the output of the detector generated by a tractor having two axles and its semi-trailer having three axles.

Figure 21 shows the voltage signal with different sensitivity at the output of the detector generated by a tractor having two axles and its semi-trailer having three axles, of which the first axle is noted.

Figure 22 is a table of the categories and their silhouettes which can be identified by the device according to the invention.

According to the invention and as shown in figures 1 to 21 of the accompanying drawings, the device for detecting, in particular, one or more wheels of a rolling vehicle or machine comprising at least one electromagnetic loop and one evaluating unit is essentially characterised in that the electromagnetic loop or loops 2 each composed of one or more turns has (have), on the one hand, a small dimension l in the direction of travel of the vehicles or of the axis X of the roadway 1, smaller than the diameter of the wheels of the vehicles to be identified and, on the other hand, a preferably rectangular shape and/or an arrangement disposed perpendicularly to the axis X of the roadway 1, the loop or loops 2 being disposed at least in the region of one or two of the rolling tracks 1" of a lane 1' of the roadway 1 and being separately and opposingly sensitive to the electromagnetic influences, on the one hand, of the metallic masses of the parts of the vehicle (body, chassis, bottom) and, on the other hand, of the metallic masses of the corresponding wheels.

The loop or loops 2 advantageously has (have) inductance between 40 and 700 $\mu$H and consists (consist) of n turns (n being between 1 and 10) of an insulated conductive wire having a cross-sectional area of about 0.2 to 3 $mm^2$ disposed on or in the roadway 1.

According to a first characteristic of the invention shown in figure 1 of the accompanying drawings, the evaluating unit is composed, on the one hand, of an electromagnetic detector 3 noting the variations of voltage and of frequency (generated by the induced current) of an alternating signal passing through the loop or loops 2 connected to it and delivering a proportional signal corresponding to said variations, on the other hand, of a signal-processing card 4 analysing the signal emitted from said electromagnetic detector 3 and determining, in particular, by microprocessor means controlled by a computer program, the number of wheels belonging to the same vehicle for its classification and, finally, a memory 5 for storage of data delivered by said processing card, adapted to the read in situ and/or remotely, with optional transfer of its contents, the elements 3 to 5 of said evaluating unit being mounted in a protective casing disposed adjacent or not to the roadway 1.

The electromagnetic detector 3, for example of the type known by the designation SL29C and marketed by the company CFEE (two-way detector with automatic control), consequently detects the resultant of the variations in voltage and frequency of an alternating signal in the loop or loops 2 due, on the one hand, to the metallic masses of the vehicle (body, bottom, chassis, engine, in particular) and, on the other hand, to the metallic masses of the wheel or wheels, more particularly the corresponding tyre or tyres of the vehicle to be investigated, in particular the variation in the inductance of the circuit constituted by each loop 2.

The frequency $f = 1/(2\pi\sqrt{LC})$ of the oscillator made up in this way is compared to the frequency of a stationary oscillator. This frequency is applied to the input of a phase-locked loop circuit of which the role is to supply a direct-current voltage at its output in relation to the input frequency. The resultant signal at the output of the loop/detector pair is characteristic of the number of wheels and therefore of axles but also of the casing (body - chassis) of the vehicle

representing its length and of its distance from the roadway 1. The variation in voltage due to a wheel during its passage past a loop is of the order of 200 to 800 millivolts (for the aforementioned type of detector - figures 18 and 21) and is opposed to the direction of the variation generated by the metallic masses of the parts of this same vehicle.

In fact, a loop 2 according to the invention, associated with an electromagnetic detector 3 separately demonstrates the influence of the vehicle body or chassis and the influence of the wheels, more particularly the tyres, but also of the disks, drums, wheel rims, etc. on the frequency of the signal passing through the loop or loops 2.

Therefore, these influences generate opposing or reverse variations in the frequency and the voltage of said signal, as shown in figures 18 to 21 which show direct-current voltage signals delivered by the electromagnetic detector 3 and of which the amplitudes vary as a function of the frequency variations in the signals passing through the loops 2.

These results could be explained by the fact that as the loop or loops 2 constitute a first circuit provided with a generator, the metallic masses of a vehicle, passing above such a circuit generate a variation in the magnetic field produced round said first circuit and, consequently, a variation in the flux taken in by a second circuit constituted by the metallic masses of the wheel and, more particularly, by the torus formed by the wheel rim and the metallic reinforcements of the tyre during its passage over said first circuit.

This second circuit will therefore be the seat of an induced current obeying Lenz's law.

Similarly, a return circuit current is created in said first circuit constituted by the loop or loops 2. Now, according to the above-mentioned law, the effects of the induced current

will tend toward the cause which created it, and this explains the opposing variations in the received signals.

Furthermore, the two aforementioned circuits have mutual inductance between themselves with variable permeability owing to the presence of metallic elements in translation and metallic elements in rotation.

Figures 18 to 21 show clearly the positive variations in the form of a plateau or flattened dome generated by the vehicle body or chassis under consideration and the peaks of negative variation generated by the rotating wheels of said vehicle (relative to the reference R of the signal in the form of a resting voltage of a few volts corresponding to zero variation in the voltage frequency).

It is even possible to note in figure 20 small positive peaks integrated in the negative peaks corresponding to the passage of the wheel features (suspension, journal, bridge, support, etc.) past the loop 2.

It should also be mentioned that the amplitude of the signals received in the region of the magnetic detector 3 is independent of the speed at which the vehicle passes over the loop or loops 2, resulting in identical sensitivity of measurement and analysis at low speed and at high speed.

It is also possible to determine, in particular, whether a heavy goods vehicle has one or more wheels or axles.

In fact, as shown in figure 21 of the accompanying drawings, a noted wheel or axle causes a variation in the signal in the same sense as the metallic mass of the body or chassis (see positive peak preceding the two negative peaks in figure 21).

The computer program, derived if applicable from a known signal processing program, like the signal-processing card 4 advantageously allows the classification of the vehicles by

category, discriminating between them by means of the number of axles, the distances between axles, the length of the body or chassis and the distances between the roadway and the bottom, on the one hand, between the axles and, on the other hand, to the front and rear of the axles.

These last distances are specific characteristics of the morphology of certain vehicles, in particular buses and coaches having a low lateral metallic casing.

According to a preferred embodiment of the invention, the dimension 1 or width of the loop or loops 2 in the direction of travel of the vehicles to be analysed or the axis X of the roadway 1 is substantially equal to the width of the bearing surface on the ground for the tyres of the vehicle wheels to be analysed (substantially similar dimensions).

Therefore, the width 1 of the loop or loops 2 is preferably about 0.3 metre for the detection of heavy goods vehicle wheels and preferably about 0.15 metre for the detection of light vehicle wheels.

According to a first variation of the invention shown in figures 3 and 5 of the accompanying drawings, the detection device comprises one or two rectangular loops 2 having a length L comprised between 0.50 m and 1.20 m and each disposed on or below a rolling track 1" of a lane 1' perpendicularly to the longitudinal axis thereof.

According to a second variation shown in figure 4 of the accompanying drawings, said detection device comprises a single rectangular loop 2 for the two rolling tracks 1" of a lane 1'.

According to a third variation of the invention shown in figures 12 to 16 of the accompanying drawings, said detection device comprises an assembly of two loops 2 constituted by a same conductive wire connected to a single detector 3 and of

which each is placed on or below one of the two rolling tracks 1" of the wheels of a same lane 1' of the roadway 1, each of said loops 2 being able to comprise an identical or indifferent given number of turns.

According to a fourth embodiment there is provided an assembly of at least two loops 2 each connected to a separate electromagnetic detector 3 and disposed in an alignment perpendicular to the axis X of the roadway 1 or to the direction of travel of the vehicles, said loop assembly 2 extending either on or below a single rolling track 1" of the lane 1' or over substantially the entire width of the lane 1" (figures 6 to 10).

Although the loop or loops 2 preferably have a rectangular shape, they can also be of a different shape, that is a parallelogram, square or round shape (figures 6 to 10) or oval or elliptical shape (not shown).

Furthermore, in the case of an arrangement or alignment of several loops 2, the loops can be separated, tangential (figure 8) or secantal.

To enable them to be installed on or in the roadway, the loop or loops 2 can be secured to one or more flexible and strong sheets or strips which may be woven, have identical or complementary characteristics and consist, for example, of rubber, plastic, synthetic or resinous products, these sheets or strips being adapted to sandwich the wires of the turns of the loop or loops 2, to have a self-adhesive face permitting adhesion of the loop or loops 2 to the roadway 1 and themselves consisting of marking strips, for example stop lines, "give way" lines, centre lines or side lines or the like.

Therefore, said loop or loops 2 can be secured to one or more sheets constituting temporary supports, open-worked as the case may be, disposed on the roadway 1 and secured together by

a localised or overall coating penetrating the openings, the sheets being biodegradable or soluble by a component in particular of the binder of the coating or by heat.

According to a characteristic of the invention, the detection device can also be associated or integrated with another system for the detection and reception of data relating to vehicles such as, for example, an electromagnetic loop device of large size, a piezo-electric detector, a resistive detector, a piezo-polymeric detector, an optical detector, an ultra high-frequency detector or an ultrasonic detector, so as to receive supplemental data relating to the vehicle to be investigated, permitting further refinement of the identification of said vehicle.

As shown in figure 11 of the accompanying drawings, the detection device according to the invention can also comprise a loop 2 of small size in the direction of travel of the vehicles, disposed in a large loop 2' the two loops 2 and 2' being made of the same conductive wire connected to a same electromagnetic detector 3 allowing the length and speed of travel of the vehicle to be investigated to be determined.

The present invention also relates to a process for the detection, analysis and classification of rolling vehicles using the device described hereinbefore, characterised in that it consists in noting the electromagnetic influences, on the one hand, of the metallic masses of a vehicle body or chassis and, on the other hand, of the metallic masses of the tyres of the wheels of said vehicle, separately and opposingly, by means of at least one electromagnetic loop 2 disposed on or in the roadway 1 and having a small dimension in the direction of travel of the vehicles or of the axis X of the roadway 1, in producing a signal indicating the number and position of the wheels relative to each other and relative to the vehicle body or chassis, in identifying the precise nature of the analysed vehicle and in classifying it within predetermined categories based essentially on the number and longitudinal arrangement

of the wheels or of the axles, and in storing the received data for a determined period of time for their subsequent use.

According to a characteristic of the invention, said process can consist, in particular, in noting the variation in electromagnetic magnitudes or frequency or voltage of an alternating signal passing through the loop or loops 2 during the passage of a vehicle over the loop or loops 2 owing to the electromagnetic influence, in particular as to the inductance of the loop or loops 2, of the vehicle body or chassis, on the one hand, and the tyres of the corresponding wheels, on the other hand.

According to a variation of the invention, said process can consist, by means of several independent loops 2 disposed perpendicularly to the axis X of the roadway 1 and each producing its own signal, in noting transversely the position of one or more single or double wheels of a given vehicle, and therefore the position thereof on the lane 1', and in scanning said vehicle by longitudinal sections, thereby permitting reconstitution of the imprint or the magnetic signature of said vehicle allowing precise comparative identification thereof.

Said process will advantageously also allow the length of the body or of the chassis and the distances between the roadway 1 and the bottom of the chassis between the axles, on the one hand, and to the front and rear of the axles, on the other hand, to be determined.

According to a further variation of the invention, said process can also consist in the supplemental use of an ultrasonic detector to determine the profile or silhouette of the vehicle to be analysed so a distinction can be made between two vehicles both provided with five axles but of which one comprises a flat semi-trailer and the other has a tarpaulin.

According to a further variation of the invention, it is possible, by the supplemental use of an electromagnetic loop 2' of large size associated with a loop 2 as described above, these two loops being constituted by the same conductive wire (therefore connected in series), also to determine, by analysis of the received signal, the speed of travel and the length of detected vehicles.

In fact, these last data can be deduced from the distances between the successive fronts of attack of the signal received by the electromagnetic detector 3 connected to said loops 2 and 2' corresponding to the passage of said vehicle past the loop 2 and the loop 2'.

According to a characteristic of the invention, the prior installation of the loop or loops 2 in the roadway 1 can advantageously be achieved by means of a saw permitting suitable imprints or cut-outs of 2 to 3 cm in width and depth to be obtained in said roadway 1.

The device according to the invention is intended, in particular, for

- counting axles
- counting single or double wheels
- counting vehicles
- counting vehicles by category
- determining the transverse position of the wheels relative to a reference, preferably the axis of the lane
- determining the transverse position of the vehicles relative to a reference, preferably the axis of the lane
- determining the longitudinal position of the wheels of a same vehicle allowing classification by category, inter-axle spacing
- discriminating atypical vehicles by their signature
- discriminating between a single wheel and double wheels
- measuring speed, distance between vehicles, length of vehicles

- identifying atypical vehicles and aircraft, for example at airports.

The invention is obviously not limited to the embodiments described and illustrated in the accompanying drawings. Modifications are possible, in particular with regard to the constitution of the various elements or by substitution of technical equivalents, without departing from the scope of protection of the invention.

Claims

1. Device constituted by at least one electromagnetic loop positioned on or in the roadway and by a unit for evaluating the influence of the passage of a vehicle past said loop or loops, the electromagnetic loop or loops (2) each being composed of one or more turns and having, on the one hand, a small dimension (1) in the direction of travel of the vehicles or of the axis (X) of the roadway (1), and, on the other hand, a preferably rectangular shape and/or an arrangement disposed perpendicularly to the axis (X) of the roadway (1), the loop or loops (2) being disposed at least in the region of one or two of the rolling tracks (1") of a lane (1') of the roadway (1), characterised in that the dimension (1) or width of the loop or loops (2) is substantially equal to the width of the bearing surface on the ground for the wheels of the vehicles to be analysed, that is preferably about 0.3 metre for the detection of heavy goods vehicles and about 0.15 metre for the detection of light vehicles and in that the evaluating unit is composed, on the one hand, of an electromagnetic detector (3) noting the variations of voltage and of frequency of an alternating signal passing through the loop or loops (2) connected to it by virtue of the passage of a vehicle past the loop or loops (2) and delivering a proportional signal corresponding to said variations, on the other hand, of a signal-processing card (4) analysing the signal emitted from the electromagnetic detector (3) and determining, in particular, by microprocessor means controlled by a computer program, the number of wheels belonging to the same vehicle for its classification and, finally, a memory (5) for storage of data delivered by said processing card, adapted to be read in situ and/or remotely, with optional transfer of its contents, the elements (3 to 5) of said evaluating unit advantageously being mounted in a protective casing, disposed adjacent or not to the roadway (1).

2. Device according to claim 1, characterised in that the computer program permits the classification of the vehicles by category, discriminating between them by means of the number of axles, the distances between axles, the length of the body or chassis and the distances between the roadway and the bottom of the body, on the one hand, between the axles and, on the other hand, to the front or rear of the axles.

3. Device according to any one of claims 1 and 2, characterised in that it comprises one or two rectangular loops (2) having a length (L) comprised between 0.50 m and 1.20 m and each disposed on or below a rolling track (1") of a lane (1') perpendicularly to the longitudinal axis thereof.

4. Device according to any one of claims 1 and 2, characterised in that it comprises a single rectangular loop (2) for the two rolling tracks (1") of a lane (1').

5. Device according to any one of claims 1 to 3, characterised in that it comprises an assembly of two loops (2), constituted by a same conductive wire connected to a single detector (3) and of which each is disposed on or below one of the two rolling tracks (1") of a same lane (1') of the roadway (1).

6. Device according to any one of claims 1 to 3, characterised in that it comprises an assembly of at least two loops (2), each connected to a separate electromagnetic detector (3) and disposed in an alignment perpendicular to the axis (X) of the roadway (1) or to the direction of travel of the vehicles, said loop assembly (2) extending either on or below a single rolling track (1") of the lane (1'), or over substantially the entire width of the lane (1).

7. Device according to any one of claims 1 to 2, 5 and 6, characterised in that the loop or loops (2) have a shape other than rectangular, such as for example a parallelogram, square, round, oval or elliptical shape and in that, in the case of an arrangement, alignment or assembly of several loops (2), the loops (2) are either separated or are tangential or secantal to each other.

8. Device according to any one of claims 1 to 7, characterised in that the loop or loops (2) are secured to one or more flexible and strong sheets or strips, which may be woven, have identical or complementary characteristics and consist for example of rubber, plastic, synthetic or resinous products, these sheets or strips being adapted to sandwich the wires of the turns of the loop or loops (2), to have a self-adhesive face permitting adhesion of the loop or loops (2) to the roadway (1) and themselves consisting of marking strips, for example stop lines, "give way" lines, centre lines or side lines or the like.

9. Device according to claim 8, characterised in that the loop or loops (2) are secured to one or more sheets constituting temporary supports, open-worked as the case may be, disposed on the roadway (1) and secured together by a localised or overall coating penetrating the openings, the sheets being adapted to be biodegradable or soluble by a component in particular of the binder of the coating or by heat.

10. Device according to any one of claims 1 to 9, characterised in that it is associated or integrated with another system for the detection and reception of data relating to the vehicles such as for example an electromagnetic loop of large size, a piezo-electric detector, a resistive detector, a piezo-polymeric detector, an optical detector, a ultrahigh-frequency detector or an ultrasonic detector, so as to receive supplemental data relating to the vehicle to be investigated, permitting further refinement of the identification of said vehicle.

11. Device according to any one of claims 1 to 10, characterised in that it comprises a loop (2) of small size in the direction of travel of the vehicles, disposed in a large loop (2'), the two loops (2 and 2') being made of the same conductive wire connected to a same electromagnetic detector (3).

12. Process for the detection, analysis and classification of rolling vehicles or machinery using the device according to any one of claims 1 to 11, consisting in noting the electromagnetic influences associated with the passage of a vehicle, by means of at least one electromagnetic loop (2), disposed on or within the roadway (1) and having a small dimension in the direction of travel of the vehicles or of the axis (X) of the roadway (1), characterised in that it consists, by means of at least one loop (2) whose dimension (1) or width is substantially equal to the width of the bearing surface on the ground for the vehicles to be analysed, in noting first the opposite variations of voltage and/or frequency of an alternating signal passing through the loop or loops (2) associated, on the one hand, with the wheels of the vehicles and, on the other hand, with the body or chassis of said vehicles, in processing the signal proportional to said variations, in producing a signal indicating the number and position of the wheels relative to each other and relative to the body of the vehicle, in identifying the precise nature of the analysed vehicle and in classifying it within predetermined categories, based essentially on the number and longitudinal arrangement of the wheels or of the axles, and in storing the received data for a determined period of time for their subsequent use, for reading in situ and/or remotely, with optional transfer of its contents.

13. Process according to claim 12, characterised in that it consists in noting the variation of electromagnetic magnitudes or frequency or voltage of an alternating signal passing through the loop or loops (2), during passage of a vehicle over the loop or loops (2), owing to the electromagnetic influence, in particular as to the inductance of the loop or loops (2), of the body or the chassis of the vehicle, on the one hand, and the corresponding wheels, on the other hand.

14. Process according to any one of claims 12 and 13, characterised in that it consists, by means of several independent loops (2) disposed perpendicularly to the axis (X) of the roadway (1) and each producing its own signal, in noting transversely the position of one or more single or double wheels of a given vehicle, and therefore the position thereof on the lane (1'), and in scanning said vehicle by longitudinal sections, thereby permitting reconstitution of the imprint or the magnetic signature of said vehicle allowing precise comparative identification thereof.

15. Process according to any one of claims 12 to 14, characterised in that it consists in also determining the length of the body or of the chassis and the distances between the roadway (1) and the bottom of the chassis between the axles, on the one hand, and to the front and rear of the axles, on the other hand.

16. Process according to any one of claims 12 to 15, characterised in that it consists in the supplemental use of an ultrasonic detector, to determine the profile or silhouette of the vehicle to be analysed.

17. Process according to any one of claims 12 to 16, characterised in that it consists in the supplemental use of an electromagnetic loop (2') of large size, associated with a loop (2) constituted by the same conductive wire, also to determine, by analysis of the received signal, the speed of travel and the length of detected vehicles.

18. Process according to any one of claims 12 to 17, characterised in that it consists first of installing the loop or loops (2) in the roadway (1) by means of a saw permitting suitable imprints or cut-outs to be obtained in said roadway (1).

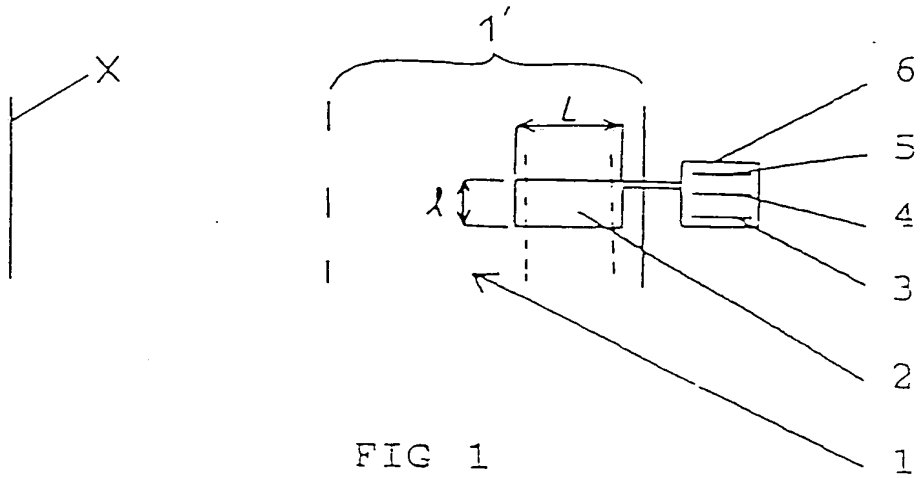



FIG 1

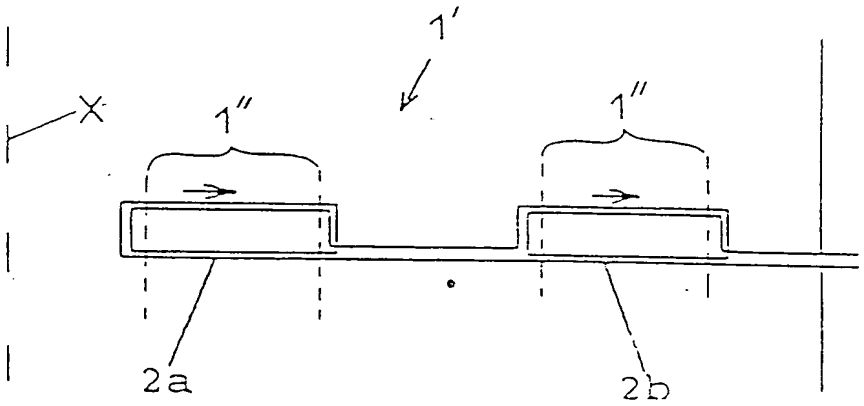



FIG 2

FIG 3

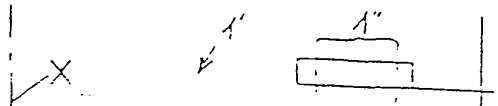



FIG 4

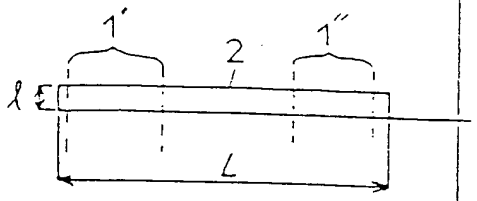



FIG 5

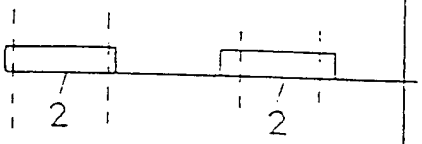



FIG 6

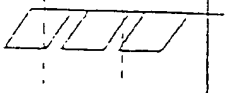


FIG 7

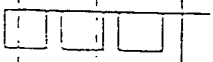


FIG 8

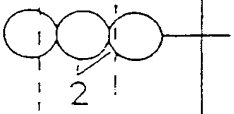



FIG 9

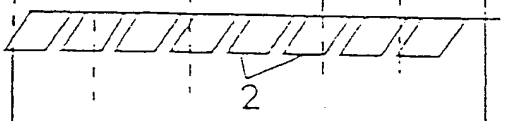



FIG 10

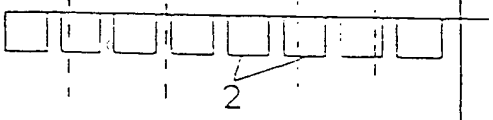



FIG 11

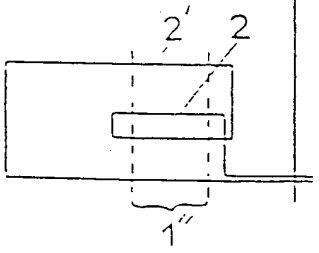


FIG 12

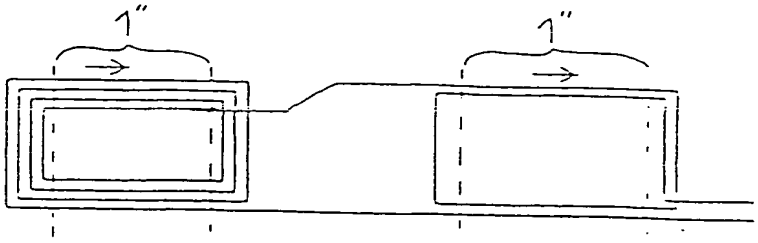



FIG 13

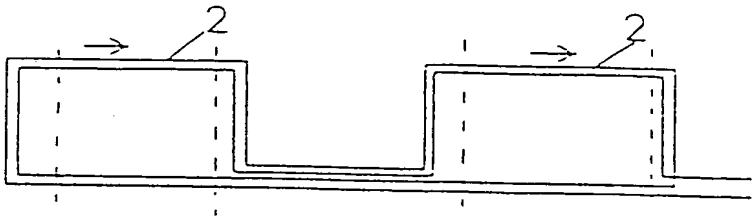



FIG 14

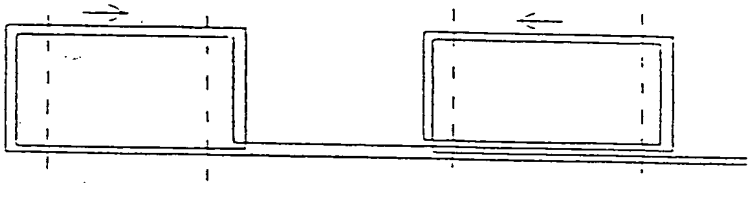


FIG 15

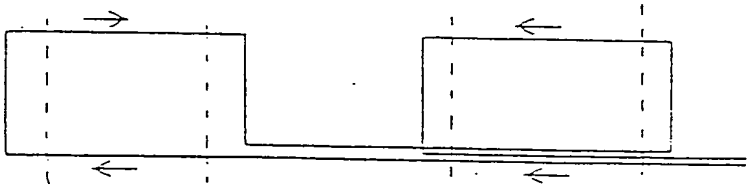


FIG 16

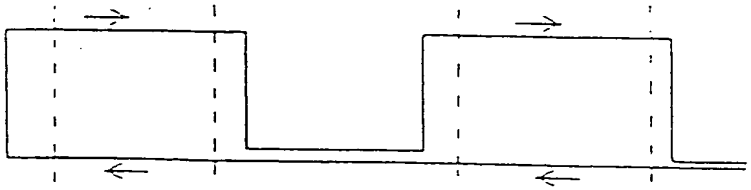
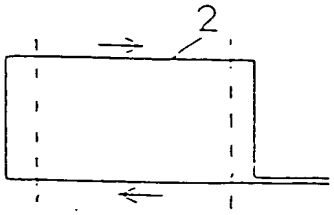


FIG 17



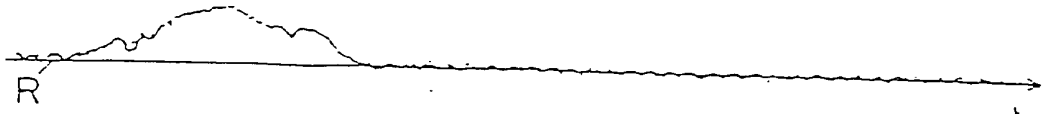



FIG. 18

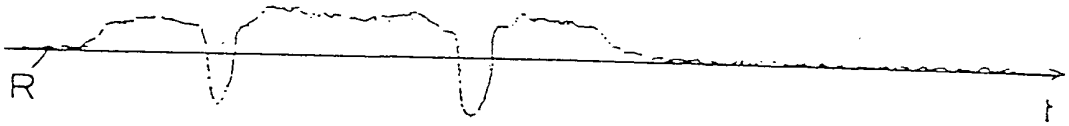



FIG. 19

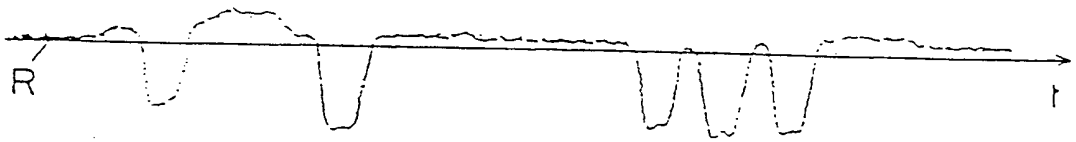



FIG.20

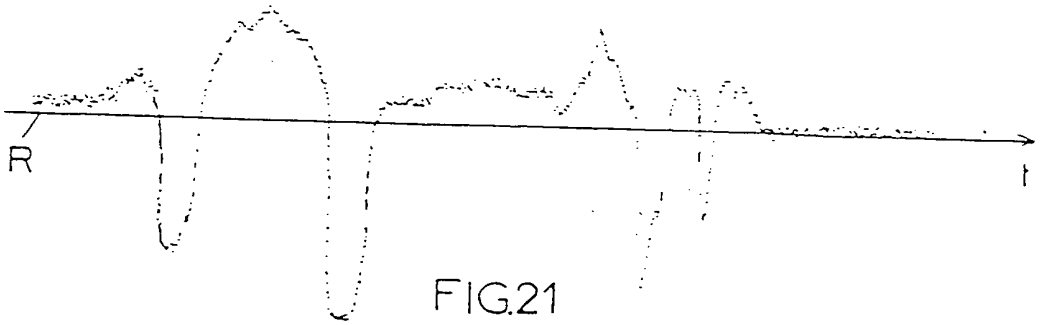



FIG.21

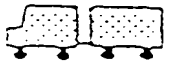
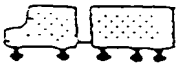
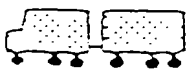
| Number of Axles | Total weight permitted | Classification Category | Classification Type | Silhouettes |
|---|---|---|---|---|
| 2 | 19 t. | P. 1 | 1 |  |
| 3 | 26 t. | P. 2 | 2 |  |
| | | | 3 |  |
| 4 | 38 t. | P. 3 | 4 |  |
| | | | 7 |  |
| 5 & 6 | 40 t. | P. 4 | 5 |  |
| | | | 6 |  |
| | | | 8 |  |
| | | | 9 |  |
| | | | 10 |  |
| | | | 11 | Others |
| | | | 12 | V.L. |

FIG 22

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 649 553 B1

(12) # FASCICULE DE BREVET EUROPEEN

(45) Date de publication et mention de la délivrance du brevet:
**27.12.1996 Bulletin 1996/52**

(21) Numéro de dépôt: **93914823.5**

(22) Date de dépôt: **06.07.1993**

(51) Int Cl.[6]: **G08G 1/015**, G08G 1/042

(86) Numéro de dépôt international:
**PCT/FR93/00699**

(87) Numéro de publication internationale:
**WO 94/01847 (20.01.1994 Gazette 1994/03)**

(54) **DISPOSITIF ET PROCEDE POUR DETECTER UNE OU PLUSIEURS ROUES D'UN VEHICULE**

VORRICHTUNG UND VERFAHREN ZUM ERKENNEN VON EINEM ODER MEHREREN FAHRZEUGRÄDERN.

DEVICE AND PROCESS FOR THE DETECTION OF ONE OR MORE VEHICLE WHEELS

(84) Etats contractants désignés:
**AT CH DE ES FR GB LI**

(30) Priorité: **06.07.1992 FR 9208416**

(43) Date de publication de la demande:
**26.04.1995 Bulletin 1995/17**

(73) Titulaire: **CENTRE D'ETUDES TECHNIQUES DE L'EQUIPEMENT DE L'EST**
**57076 Metz Cedex 03 (FR)**

(72) Inventeur: **STANCZYK, Daniel**
**F-54800 Jarny (FR)**

(74) Mandataire: **Nuss, Pierre et al**
**10, rue Jacques Kablé**
**67080 Strasbourg Cédex (FR)**

(56) Documents cités:
**EP-A- 0 035 960**
**DE-A- 1 959 546**
**DE-A- 3 100 724**
**FR-A- 1 555 538**
**FR-A- 2 254 842**
**FR-A- 2 549 625**
**US-A- 3 312 935**
**US-A- 4 945 356**



EP 0 649 553 B1

Printed by Jouve, 75001 PARIS (FR)

This Page Blank (uspto)